We claim:

1    1.    A method of imaging tissue comprising:

2    a)    administering a composition having a general formula S-L-X, wherein:

3    the X moiety is a carbon compound substituted with at least one atom

4    having a K-absorption edge of about 13 keV to about 90 keV;

5    the S moiety is a binding moiety;

6    the L moiety is bonded to the S moiety and to the X moiety; and

7    the global logP value of said composition is greater than about 0.0;

8    b)    generating an X-ray beam;

9    c)    illuminating said tissue with said X-ray beam; and

10    c)    acquiring a radiographic image of said tissue during illumination.

1    2.    The method of claim 1 wherein said acquiring occurs during said illuminating

2    and wherein said tissue is in vivo.

1    3.    The method of claim 1 wherein the global logP value of said composition is

2    greater than about 1.0.

1    4.    The method of claim 1 wherein said X moiety is further substituted with at least

2    one moiety having a logP value of less than about 0.0.

1    5.    The method of claim 1 wherein the X moiety is further substituted with at least

2    one moiety having a logP value of less than about 1.0.

1    6.    The method of claim 1 wherein said composition is bidirectionally cell

2    membrane-permeable.

1    7.    The method of claim 1 wherein said composition is capable of binding to a
2          cellular target.

1    8.    The method of claim 1 wherein said composition is capable of binding to an
2          enzyme.

1    9.    The method of claim 1 wherein said composition is capable of binding to
2          hexokinase.

1    10.   A method of imaging tissue comprising:
2          a)    administering a composition having a general formula S-L-X, wherein:
3                      the X moiety is a carbon compound substituted with at least one atom
4                having a K-absorption edge of about 13 keV to about 90 keV;
5                      the S moiety is a binding moiety;
6                      the L moiety is bonded to the S moiety and to the X moiety; and
7                      the global logP value of said composition is greater than about 0.0;
8          b)    generating a plurality of X-ray beams with predetermined different energy
9                spectra;
10         c)    illuminating said tissue with each of said plurality of beams;
11         d)    acquiring a radiographic image of said tissue during illumination by each of
12                said plurality of beams; and
13         e)    generating a single image from at least two of said radiographic images.

1    11.   The method of claim 10 wherein said acquiring occurs during said illuminating
2          and wherein said tissue is in vivo.

1    12.   The method of claim 10 wherein said plurality of beams are quasi-
2          monoenergetic.

1     **13.** The method of claim **10** wherein said plurality of beams are monoenergetic.

1     **14.** The method of claim **10** wherein 2 beams are generated.

1     **15.** The method of claim **10** wherein more than 2 beams are generated.

1     **16.** The method of claim **10** wherein means for generating said plurality of beams
2     with predetermined different energy spectra is disposed between means for
3     generating said X-ray beam and said tissue.

1     **17.** The method of claim **10** wherein means for generating said plurality of beams
2     with predetermined different energy spectra is disposed between said tissue
3     and means for said acquiring of radiographic images.

1     **18.** The method of claim **10,** further including displaying variable proportions of
2     radiographic density contributed by said composition, soft tissue, and bone to
3     said single image.

1     **19.** The method of claim **10** wherein the global logP value of said composition is
2     greater than about 1.0.

1     **20.** The method of claim **10** wherein said X moiety is further substituted with at
2     least one moiety having a logP value of less than about 0.0.

1     **21.** The method of claim **10** wherein the X moiety is further substituted with at least
2     one moiety having a logP value of less than about 1.0.

1     **22.** The method of claim **10** wherein said composition is bidirectionally cell
2     membrane-permeable.

1    23.    The method of claim 10 wherein said composition is capable of binding to a
2           cellular target.

1    24.    The method of claim 10 wherein said composition is capable of binding to an
2           enzyme.

1    25.    The method of claim 10 wherein said composition is capable of binding to
2           hexokinase.

1  26.    A composition having the general formula

X
 \
  |
  L
  |
   \
    S
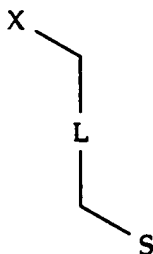
2
3    wherein:

4           the X moiety is selected from alkyl, alkoxy, alkylthio, alkenyl, alkylamino and

5    aryl, and is substituted with at least one atom having a K-absorption edge of about 13

6    keV to about 90 keV;

7           the S moiety is selected from pyranose and furanose;

8           the L moiety is selected from aryl, arylamido, alkylamido, alkyl, and thioamido,

9    and is bonded to said X moiety and to said S moiety.

1    27.    The composition of claim 26 wherein said at least one atom of said X moiety is
2           selected from Br, I, and Bi.

1    28.    The composition of claim 26 wherein said X moiety is further substituted with at

2              least one group selected from hydroxyalkyl, alkoxy, alkloxyalkyl, alkylamido,

3              hydroxyalkylamido, and polyhydroxyalkylamido.

1    29.    The composition of claim 26 wherein said L moiety is an unsubstituted or

2              substituted amidoaryl and is N-bonded to said S moiety.

1    30.    The composition of claim 26 wherein said L moiety is further substituted with at

2              least one group selected from nitro, amino, methyl, methoxy, and hydroxy.

1    31.    The composition of claim 26 wherein said L moiety contains at least one N atom

2              and is N-bonded to the S moiety.

1    32.    The composition of claim 26 wherein said S moiety is hydroxy-substituted.

1    33.    The composition of claim 26 wherein said S moiety is 2-hydroxy-substituted.

1    34.    The composition of claim 26 which is 2-Amino-4-[3',5'-bis(N-acetamido)-2',4',6'-

2              triiodophenyl]-benzoyl-D-glucosamine.

1    35.    The composition of claim 26 which is 2,6-Diamino-4-[3',5'-bis(N-

2              methylacetamido)-2',4',6'-triiodophenyl]-benzoyl-D-glucosamine.

1    36.    The composition of claim 26 which is 2-Amino-4-[3'5'-bis(2,3-

2              dihydroxypropylmethylcarbamoyl)-2',4',6'-triiodophenyl]-benzoyl-D-

3              glucosamine.

1    37.    The composition of claim 26 in which said X moiety is substituted with at least

2              one atom of a radioisotope.

1    38.   The composition of claim 26 in which said X moiety is substituted with at least

2          one atom of $^{123}$I.

1    39.   The composition of claim 26 which is [$^{123}$I]-2-Amino-4-[3',5'-bis(N-acetamido)-

2          2',4',6'-triiodophenyl]-benzoyl-D-glucosamine.

1    40.   The composition of claim 26 which is [ $^{123}$I]-2-Diamino-4-[3',5'-bis(N-

2          methylacetamido)-2',4',6'-triiodophenyl]-benzoyl-D-glucosamine.

1    41.   The composition of claim 26 which is [$^{123}$I]-2-Amino-4-[3'5'-bis(2,3-

2          dihydroxypropylmethylcarbamoyl)-2',4',6'-triiodophenyl]-benzoyl-D-

3          glucosamine.

1    42.  A composition having the general formula

```
X
 \
  |
  |
  L
  |
   \
    \
     S
```

2
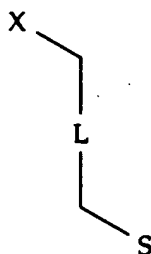
3    wherein:

4          the X moiety is an aryl substituted with at least one atom having a K-absorption

5    edge of about 13 keV to about 90 keV;

6          the S moiety is selected from pyranose and furanose;

7          the L moiety is bonded to the S moiety and to the X moiety; and

8          the global logP value of said composition is greater than about 0.0.

1    43.   The composition of claim 42 wherein the global logP value is greater than about

2          1.0.

1     **44.**     The composition of claim **42** wherein said X moiety is further substituted with at

2                least one moiety having a logP value of less than about 0.0.

1     **45.**     The composition of claim **42** wherein the X moiety is further substituted with at

2                least one moiety having a logP value of less than about 1.0.

1     **46.**     The composition of claim **42** which is bidirectionally cell membrane-permeable.

1     **47.**     The composition of claim **42** which is capable of binding to a cellular target.

1     **48.**     The composition of claim **42** which is capable of binding to the substrate binding

2                site of an enzyme.

1     **49.**     The composition of claim **42** which is capable of binding to the substrate binding

2                site of hexokinase.